Physics 126
Section B01

Wednesday Feb. 9 2011
Instructor: Wheelock, M.
CCIS 1-430 12:00 – 12:48

Winter 2011 -- Midterm Exam 1
Exam is worth a total of 16 points

PLEASE DO NOT OPEN YOUR EXAM UNTIL YOU ARE TOLD TO DO SO.
You may begin filling out your Scan-Tron form.

Exam is Multiple Choice. There are 16 multiple choice questions. Please read ALL answers and select the ONE BEST answer. Bubble in your answers in pencil on the Scan-tron Answer Sheet. Answers written on this handout will NOT be marked. Equation sheet is attached at the back of this handout.

ON THE SCAN-TRON ANSWER SHEET, PLEASE ENTER THE FOLLOWING:

YOUR NAME [Surname first, then a space, followed by your given name]
STUDENT ID NUMBER [seven digits]
SPECIAL CODES: see next page for exam version number

You MUST fill in the bubbles with the above info or your exam will not be marked.

TAKE A DEEP BREATH!
RELAX!

Good luck!

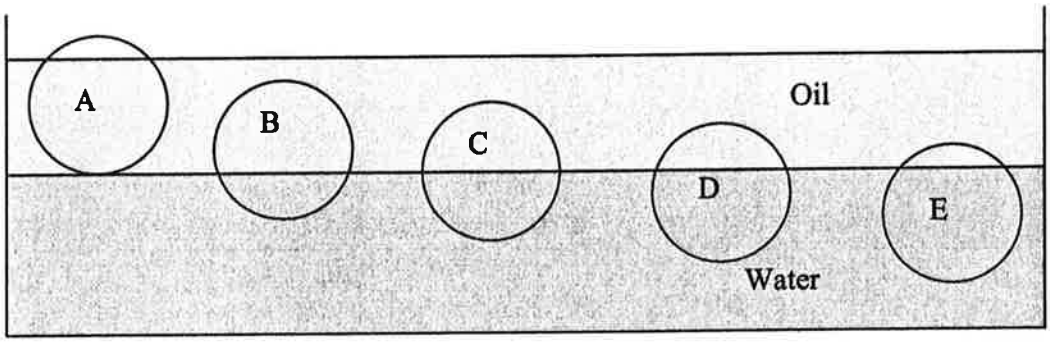
When the exam period is over, please stop working immediately.
Turn in your ScanTron sheet directly to your instructor or TA.

IMPORTANT:
On your answer sheet, under SPECIAL CODES
ENTER J = 2, K = 2

Read ALL answers and choose the ONE BEST ANSWER. Bubble in your answer on the Scan tron form. Answers written on this handout will not be marked. EQUATION SHEET is attached at the end; you may detach it.

1. Which of the following represent(s) units of pressure?
A. Pa
B. kg m^{-2}
C. J m^{-3}
D. both A and C
E. A B and C are all pressure units

2. A wooden bead has density 700 kg m^{-3}. It falls into a bucket containing water with a layer of oil floating on the water. Density of oil = 600 kg m^{-3}. Which diagram best represents the position of the bead, floating at equilibrium?



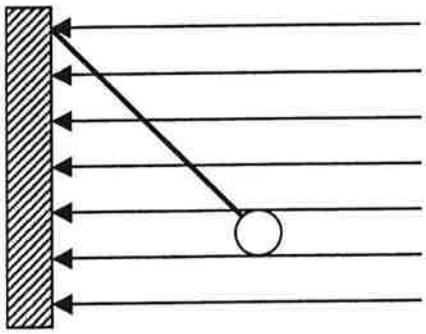
3. A viscous fluid is flowing through two pipes. Both have the same pressure drop ΔP applied across them. Pipe 1 has radius R, length L and volume flow rate Q. Pipe 2 has radius 2R and length 4L. What is the volume flow rate in pipe 2?
A. Q/8
B. Q/2
C. 2Q
D. 4Q
E. 8Q

Household plumbing (two questions). Water enters a house through a 4.0 cm diameter pipe in the basement, with a flow speed = 0.50 m/s and total pressure = 3.0 atm. The pipe carries water to the second floor bathroom, where the pipe narrows to 2.0 cm diameter at a location 5.0 m above the basement pipe. Assume that the water is flowing continuously. Density of water = 1000 kg m^{-3}. P_{at} = 1.01 x 10^5 Pa. g = 9.81 ms^{-2}.

4. What is the volume flow rate in the pipe in the upstairs bathroom?
A. 2.0 m s^{-1}
B. 1.75 m s^{-1}
C. 1.2 m s^{-1}
D. 1.0 m s^{-1}
E. 0.25 m s^{-1}

5. What is the total pressure in the pipe in the upstairs bathroom?
A. 1.0 x 10^5 Pa
B. 2.5 x 10^5 Pa
C. 1.5 x 10^5 Pa
D. 3.5 x 10^5 Pa
E. 5.0 x 10^5 Pa

The following information is relevant to the next three questions. A charged ball with mass .0010 kg hangs from a string at equilibrium in a uniform electric field (magnitude = 200 N/C) as shown in the diagram. One end of the string is fixed to a vertical wall, and it hangs at an angle θ = 40° relative to vertical.



6. What is the *sign* of the net charge on the ball?
A. positive
B. negative
C. not enough information is given to determine the sign

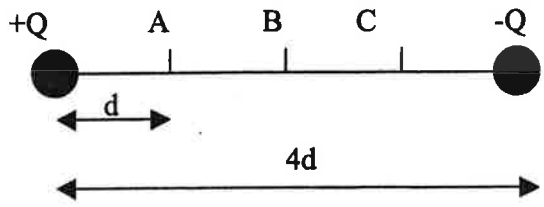
7. What is the *magnitude* of the net charge on the ball? The mass of the string is negligible. 1 μC = 10^{-6} C

A. 980 μC
B. 580 μC
C. 58 μC
D. 41 μC
E. You would need to know the length of the string to solve this problem.

8. Suppose the ball in the above problem is a solid copper sphere. What is the magnitude of the electric field at the *center* of the ball?
A. 10 N/C
B. 1000 N/C
C. 200 N/C
D. zero
E. You would need to know the radius of the ball to answer this

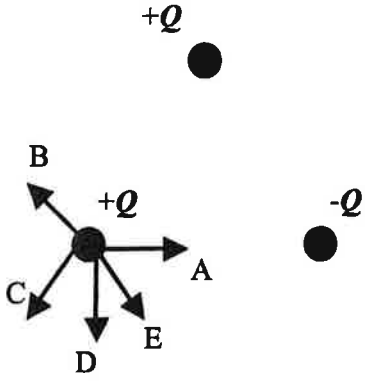
9. Two point charges are fixed on the x-axis so that +Q is at the origin, -Q is at x = 4d. Consider locations A = d, B = 2d and C = 3d. Rank the locations A, B and C in terms of the *magnitude* of the net electric field at each location.

A. A > B > C
B. C > B > A
C. A = B = C
D. A = C < B
E. A = C > B



10. Three point charges of equal magnitude (with signs as shown) are fixed at the corners of an equilateral triangle. Which arrow best illustrates the direction of the electrostatic force on the positive charge in the lower left corner?

A.
B.
C.
D.
E.



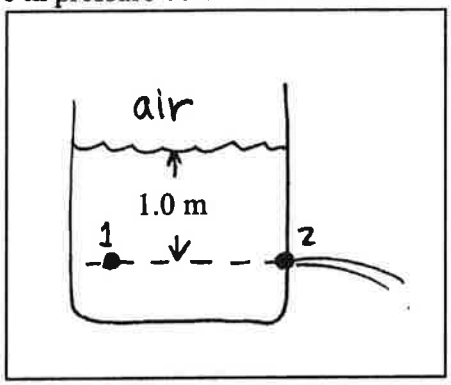
11. Which of the following was most important in the derivation of Bernoulli's equation?
A. Pascal's principle
B. Poiseuille's law
C. Archimedes' principle
D. Continuity equation
E. Conservation of energy

12. A solid ball dropped in a lake sinks through the water. As it is sinking toward the bottom, the buoyant force on the ball…
A. is **greater** than the weight of the ball and directed **upward**
B. is **less** than the weight of the ball and directed **upward**
C. is **equal** to the weight of the ball
D. is **greater** than the weight of the ball and directed **downward**
E. is **less** than the weight of the ball and directed **downward**

13. Refer to the previous question. The volume of the ball is 2.0×10^{-4} m^3. When placed in the water it has an initial velocity of zero. As it sinks, it drops a vertical distance of 15 m in 5.0 seconds. What is the mass of the ball? Treat water as an ideal fluid.
A. 0.78 kg
B. 0.45 kg
C. 0.38 kg
D. 0.23 kg
E. 0.12 kg

14. In the diagram at right, water is leaking from a hole located about 1.0 metre beneath the surface of the water. What is the difference in pressure between locations 1 and 2?

A. about 0.1 atmosphere
B. about 1 atmosphere
C. about 2 atmospheres
D. about 10 atm
E. zero; the pressures are equal

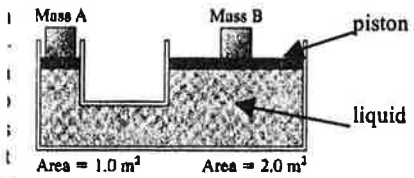


15. Refer to the information given in the previous problem. Suppose the hole at location 2 has a cross-sectional area of 4.00×10^{-4} m^2. At what rate (in m^3/s) is the tank emptying?

A. 1.8×10^{-3} m^3 s-1
B. 3.6×10^{-3} m^3 s-1
C. 4.4×10^{-3} m^3 s-1
D. 7.9×10^{-3} m^3 s-1
E. 1.2×10^{-2} m^3 s-1

16. In the hydraulic system shown, a liquid is confined by two frictionless pistons. Two masses A and mass B, rest on the pistons as shown (at equilibrium). Assume the pistons are very thin and have *negligible* mass. The cross-sectional area of piston B is twice the area of piston A. Which statement(s) is/are true?

A. Mass A must be greater than mass B
B. Mass B must be greater than mass A
C. The upward *forces* exerted by liquid on *the two pistons* must be *equal.*
D. Both A and C are true
E. Both B and C are true



Make sure you have bubbled in:
Your NAME
Your EXAM VERSION NUMBER (under special codes)
Your answers

---------Please turn in your Scan Tron form. You may keep this handout.----------

You may carefully detach this sheet.

FLUIDS

Pressure $P = F/A$ density: $\rho = M/V$

$P_1 = P_2 + \rho g h$

$P_g = P - P_{at}$

Archimedes Principle

Magnitude of the buoyant force exerted by fluid on an object is equal to the weight of fluid displaced by the object.

$V_{sub} = V_s\left(\rho_s/\rho_f\right)$ ← submerged volume of solid (s) in fluid (f)

Volume flow rate $\frac{\Delta V}{\Delta t} = Av$

Continuity equation $\rho_1 A_1 v_1 = \rho_2 A_2 v_2$

or $A_1 v_1 = A_2 v_2$

Bernoulli's equation $P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$

Torricelli's law $v = \sqrt{2gh}$

Poiseuille's equation $\frac{\Delta V}{\Delta t} = \frac{(P_1 - P_2)\pi r^4}{8\eta L}$

ELECTRIC CHARGES, FORCES AND FIELDS

Coulomb's Law $F = k\frac{|q_1||q_2|}{r^2}$ $k = 8.99 \times 10^9\ N m^2/C^2$

Electric Field $E = \frac{F}{q_0}$ $\vec{F} = q\vec{E}$

... due to a point charge: $E = \frac{k|q|}{r^2}$

Units, constants and selected equations from Phys 124:

$1\ Pa = 1\ N/m^2$

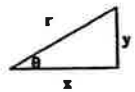
$e = 1.602 \times 10^{-19}\ C$

$k = 8.99 \times 10^9\ N\ m^2\ C^{-2}$

$P_{at} = 1.013 \times 10^5\ Pa$

Density of water $= 1000\ kg\ m^{-3}$

Quadratic: $ax^2 + bx + c = 0$, $x = \frac{-b \pm (b^2 - 4ac)^{1/2}}{2a}$



$\sin\theta = y/r$ $\cos\theta = x/r$ $\tan\theta = y/x$ $\tan\theta = \sin\theta/\cos\theta$

$\sin 2\theta = 2\sin\theta\cos\theta$ $\sin^2\theta + \cos^2\theta = 1$ $r^2 = x^2 + y^2$

Area $= \pi r^2$, Circumference $= 2\pi r$

Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$

Linear Equations of Motion:

$v = v_0 + at$ $x = \frac{1}{2}(v_0 + v)t$ $x = v_0 t + \frac{1}{2}at^2$ $v^2 = v_0^2 + 2ax$

Newton's Laws:

$\Sigma F = ma$ $W = mg$ $F_{Spring} = -kx$

Work, Energy, Power:

$W = F\cos\theta\, d$ $E_{Kinetic} = \frac{1}{2}mv^2$ $E_{Potential} = mgh$ $E_{Spring} = \frac{1}{2}kx^2$

Momentum (vector):

$p = mv$

Uniform circular motion:

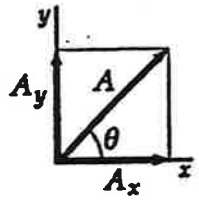
$F_{cp} = \frac{mv^2}{r}$

$a_{cp} = \frac{v^2}{r}$

$v = r\omega$ ← ω in radians/s

$\omega = 2\pi f$

$360° = 2\pi$ radians



Vectors

$A_x = A\cos\theta$

$A_y = A\sin\theta$

$A = \sqrt{A_x^2 + A_y^2}$

$\tan\theta = \frac{A_y}{A_x}$